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THE GASTEROMYCETES OF AUSTRALASIA.

vi. THE GENUS LYCOPERDON.

By G. H. CUNNINGHAM, Government Mycologist, Department of
Agriculture, Wellington, N.Z.

(Plates xlvI-xlviii.)

[Read 24th November, 1926.]

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Lycoperdon is a cosmopolitan genus of about thirty species, found in practically every country in the world, though most abundant in temperate regions.

Prior to 1890, workers included in the genus plants belonging to most of the genera now placed in the Lycoperdaceae, together with others since placed in different families and orders. At this date, Morgan (1890) published a paper in which he so clearly defined the limits of the genus and determined its relationships, that his arrangement has been generally followed by later workers, though a few European mycologists still differ somewhat, especially in not recognizing *Calvatia* as a separate genus.

Others again would still further emend *Lycoperdon*. For example, a recent North American worker has taken certain plants from *Lycoperdon* and placed them under *Bovistella*, solely because they possessed pedicellate spores. Now the main character separating *Bovistella* from *Lycoperdon* is the peculiar nature of the capillitium, pedicellate spores being either present or absent in different species of the genus. The species in question all possess *Lycoperdon* capillitia, consequently if this worker's ideas were to be followed, the generic characters of both *Bovistella* and *Lycoperdon* would be broken down.

The genus has usually been considered a difficult one for the systematist. This has arisen partly as a result of the variable nature of many of the species.

Many of the earlier workers apparently held a fixed belief that any plant from a new country must necessarily be new. Consequently we find that practically every collection sent from Australia and New Zealand to England during the last century was named as new and listed accordingly. This will be made apparent by a perusal of the list of rejected species at the end of this paper. Again, it was the practice of most of the earlier systematists to erect species upon characters which are now known to be highly variable—as, for example, the colour, size and shape of the peridium, colour of the gleba and nature of the exoperidium. Consequently as the species have become better known it was found that many so-called species were but forms of already well-known species, differing in that they were of a slightly different shape, size, colour, or possessed a more or less strongly marked exoperidium. This variability is well illustrated in *L. depressum*, where individual plants in the same collection may be cream, yellow, bay-brown or umber; globose, obconic, elliptical or subtrubinate; from 1 to 5 cm. in diameter; and the exoperidium may be of long and slender single spines, of cruciate spines, of small flattened verrucae, and even of small granules, definite spines being absent. If solitary plants of this species were encountered, workers too frequently,

noticing that they differed from the typical form, considered them as separate species and accordingly named them as new. And this may be said to have happened with most of the common species.

It has been considered unnecessary to arrange the species under sections, as is usually done, for this serves no useful purpose, but on the contrary too often tends to confusion, owing to the fact that species of this genus do not fall into well-defined groups, but tend to merge into one another.

Structure of the Mature Plant.

The plant consists of a prominent peridium of two layers (exoperidium and endoperidium) which merges into either a stem-like base or a long and slender rooting base, not unlike a tap-root in appearance. Enclosed within the peridium is a gleba, of capillitium and spores, and the lower portion is usually occupied with a prominent cellular base.

The exoperidium is of the nature of a fugacious, pseudoparenchymatous structure, which may consist of long, single or cruciate spines, verrucae, flattened verrucae or may be furfuraceous or even tomentose. In the past most species were erected upon the nature of the exoperidium, but this is perhaps the most variable character of the genus, consequently, unless well marked, should be considered of doubtful specific import. An example of this variability occurs in *L. depressum*, where the exoperidium in different plants of the same collection may be spinose, verrucose, furfuraceous or almost smooth. The exoperidium is usually fugacious, but may be partly persistent, as is frequent with *L. piriforme* and *L. compactum*.

The endoperidium persists during the lifetime of the plant, and may be tough and membranous, the common condition, or flaccid and papyraceous (*L. spadicum*, *L. pusillum*). It is usually smooth, but may be reticulated (*L. compactum*), due to the persistence of granules of the exoperidium, or covered with minute depressions like the head of a thimble (*L. subincarnatum*). It is perforated apically with a solitary, plane or erumpent stoma, differing in this respect from *Calvatia*, where dehiscence is effected by the falling away of the apical portion of the endoperidium. In *L. depressum* a stoma first appears, but is shortly followed by the disappearance of the apical portion of the peridium, as in *Calvatia*. Confusion would arise as to the generic position of this species only with old and weathered specimens; in such cases the hyaline, freely septate capillitium would show its position, being peculiar to two other species of *Lycoperdon*, *L. compactum* and *L. subincarnatum*, but not known to be present in any species of *Calvatia*.

The sterile base is usually cellular, but in *L. polymorphum* is compact and formed of interwoven hyphae of the glebal type. In two species (*L. pusillum* and *L. Gunnii*) it is absent.

The cells of the sterile base are of two types: large and readily seen with the unaided eye, and minute, when they are just perceptible. In one species, *L. depressum*, is present a prominent diaphragm which separates the sterile base from the gleba.

The gleba, of spores and capillitium, offers some of the best specific characters present in the genus. The capillitium threads may be simple, hyaline and freely septate (*L. depressum*, *L. compactum* and *L. subincarnatum*); coloured, continuous and simple or sparingly branched (*L. piriforme*, *L. perlatum*, *L. stellatum*, *L. nitidum* and *L. Gunnii*); or coloured, continuous and freely

branched (*L. spadiceum*, *L. polymorphum*, *L. pusillum*, *L. glabrescens*, *L. scabrum* and *L. asperum*), when they superficially resemble those of the genera *Bovista* and *Bovistella*. This resemblance is merely superficial, however, for the peculiar threads of the latter two genera may readily be segregated, mounted and photo-micrographed, a procedure not possible with those of *Lycoperdon*. In certain species the threads are at intervals perforated with conical pits extending to the lumen; a character which is also present in the threads of species of both *Bovista* and *Bovistella*.

A columella, formed of sterile tissue, is present in a few species (*L. piriforme*, *L. perlatum* and *L. compactum*).

The spores are usually globose, continuous, coloured and finely verruculose, though a few species possess verrucose spores. In four species (*L. glabrescens*, *L. Gunnii*, *L. scabrum* and *L. asperum*) the spores are provided with long (10-15 μ) acuminate pedicels. These are in reality the long sterigmata of the basidia, which have persisted after the breaking up of the tramal plates. Such spores are said to be pedicellate; if stumps only of the sterigmata persist attached to the spores, the latter are said to be apiculate; if neither pedicels nor stumps are present on the mature spores they are said to be apedicellate.

Most species grow upon the ground in pastures or in vegetable debris on the forest floor, but three species (*L. piriforme*, *L. compactum* and *L. subincarnatum*) grow upon rotting wood, a habitat which should aid in diagnosis of these three species.

Further details of the structure and development of a species of the genus may be obtained from a recent paper by the writer (1926).

Thanks are again due to Dr. J. B. Cleland, The University, Adelaide, Mr. C. C. Brittlebank, Melbourne, and Mr. L. Rodway, Hobart, for the loan of specimens of the genus in their possession; and to Mr. H. Drake of the Biological Laboratory, Wellington, for several of the photographs reproduced herein.

LYCOPERDON Tournefort ex Persoon.

Syn. Meth. Fung., 1801, p. 138.—*Utraria* Quel., *Bull. Soc. Myc. Fr.*, xxiv, 1876, p. 366.—*Globaria* Quel., *l.c.*, p. 370.

Peridium variously shaped, with a prominent stem-like base or rooting strand; of two layers, a fugacious exoperidium which is pseudoparenchymatous and warted, spinose or granular; and a persistent endoperidium which is membranous or papyraceous, thin, tough, and dehisces by a solitary apical stoma; sterile base present or absent; diaphragm present or absent.

Gleba of capillitium and spores; columella present or absent; capillitium threads long, simple or branched, continuous or septate, hyaline or coloured, attached by one end to the endoperidium, or columella, when present. Spores globose or shortly elliptical, continuous, rough or smooth, coloured, pedicellate or not. Basidia long-sterigmate, 4-spored.

Habitat.—Solitary, in groups, or caespitose on the ground or upon rotting wood, stumps, etc. in pastures or the forest.

Distribution.—World-wide.

Owing to the differences of opinion among systematists as to the specific value of many of the characters discussed, no definite idea as to the number of species extant may be obtained. For example Massee (1887) considers no less than 129 species. Probably the real number is in the vicinity of 30, of which 14 are present in Australia and New Zealand.

Key to the Species.

- A. Spores without distinct pedicels.
- a. Capillitium hyaline, freely septate.
- (a) Diaphragm present 1. *L. depressum*.
- (b) Diaphragm absent.
1. Endoperidium with numerous minute depressions 2. *L. subincarnatum*.
2. Endoperidium reticulate with persistent granules 3. *L. compactum*.
- b. Capillitium coloured, usually continuous.
- (a) Capillitium continuous or sparsely branched.
- * Sterile base of large cells, 2 mm. or more.
1. Exoperidium of minute connivent spines 4. *L. piriforme*.
2. Exoperidium of conspicuous pointed verrucae 5. *L. perlatum*.
- ** Sterile base of minute cells, 1 mm. or less.
1. Exoperidium of large cruciate spines 6. *L. stellatum*.
2. Exoperidium furfuraceous 7. *L. nitidum*.
- (b) Capillitium freely branched.
1. Sterile base cellular 8. *L. spadiceum*.
2. Sterile base compact 9. *L. polymorphum*.
3. Sterile base absent 10. *L. pusillum*.
- B. Spores long-pedicellate.
- a. Sterile base well developed.
1. Exoperidium furfuraceous 11. *L. glabrescens*.
2. Exoperidium of cruciate spines 12. *L. scabrum*.
- b. Sterile base scanty or absent.
1. Exoperidium of pallid, cruciate spines 13. *L. asperum*.
2. Exoperidium furfuraceous or tomentose 14. *L. Gunnii*.

1. LYCOPERDON DEPRESSUM Bonorden. Plate xlv, figs. 1-3.

Bot. Zeit., 1857, p. 611.—*L. natalense* Cke. et Mass.; Mass. in *Jour. Roy. Micr. Soc.*, 1887, p. 709.—*L. Kalchbrenneri* de Toni, in Sacc. *Syll. Fung.*, vii, 1888, p. 109.

Peridium yellow, becoming pallid brown, up to 5 cm. diam., elliptical, obconic or sub-turbinate, frequently constricted and plicate towards the base; exoperidium of white spines united at their apices, immixed with numerous simple spines and granules; larger and more numerous apically, partially disappearing with age; endoperidium ochraceous or bay brown, dehiscing by a definite apical stoma, later the whole of the apical portion falling away; sterile base occupying the lower third of the peridium, of large cells, bay- or umber-brown, separated from the gleba by a well-defined diaphragm.

Gleba yellowish, becoming pallid olivaceous; columella absent; capillitium threads hyaline, simple or sparingly branched, not pitted, septate. Spores globose, 3.5-5.5 μ diam., apedicellate; epispore pallid olivaceous, finely and closely verrucose.

Habitat.—Solitary or in small groups on the ground, often forming rings in pastures.

Distribution.—Britain; Europe; South Africa; Australia; Tasmania; New Zealand.

Victoria: *Ararat, May, 1918, E. J. Semmens; *Melbourne, May, 1910.

New South Wales: *Leura, June, 1916.

South Australia: *Mt. Lofty, Apl., 1917 (2 coll.); *National Park, June, 1917; May, 1921 (3 coll.); May, 1920 (Det. Lloyd No. 643 as *L. Wrightii*); *Beaumont, Apl., 1920; May, 1923; June, 1921; May, 1925; *Encounter Bay, Jan., 1923 (4 coll.);

* An asterisk indicates that the collection in question is in the herbarium of Dr. J. B. Cleland, Adelaide; and where the collection is preceded by an asterisk, but no collector given, it signifies that the collection was made by Dr. Cleland himself.

** A double asterisk preceding a collection indicates that the collection in question is in the herbarium of the writer; and where no collector is given, signifies that the collection was made by the writer himself.

*Adelaide, July, 1922; *Eagle on Hill, June, 1921; *Kuitpo, May, 1921; *Upper Sturt, May, 1920; *Mylor, May, 1925; *Bulls Creek, Dec., 1921.

New Zealand: *Queenstown, May, 1922 (Lloyd No. 863 as *L. cruciatum*); **Rotorua, J. Barr, June, 1919; **Tasman, Feb., 1920; **Mapua, May, 1922; **Tapanui, Mar., 1923; **Dun Mt., Nelson, June, 1923, J. C. Neill; **Whakatikei, June, 1923, J. C. Neill; **Weraroa, May, 1924; Mar., 1925, J. C. Neill; **Ashburton, Jan., Feb., Mar., Aug., 1925, J. C. Neill; **Pencarrow, Mar., 1926, J. C. Neill.

The species is characterized by the prominent diaphragm, large cellular base and hyaline, septate, simple or sparingly branched capillitium. It is the most abundant Australian and New Zealand species, is apparently common in Europe, but strangely absent from North America, where it appears to be replaced by a form Lloyd (1905b) has named *L. subpratense*, separated by its coloured capillitium.

Lloyd has recorded both *L. Wrightii* Berk. and *L. candidum* Pers. (= *L. cruciatum* Rostk.) as occurring in Australasia, but examination of specimens so determined by him in the collections of Dr. Cleland, show them to be *L. depressum*.

Lloyd (1905c) states that he believes this species is probably *L. hiemale* Vitt., and possibly *L. pratense* Pers., but has produced no evidence in support of his statement; nevertheless, the species is regularly discussed in his works under the latter name.

2. LYCOPERDON SUBINCARNATUM Peck. Plate xlvii, figs. 4-5.

N.Y. Nat. Hist. Mus. Bot. 24th Rept., 1872, No. 82.—*L. tephrum* Berk. in Herb.; Mass., Jour. Roy. Micr. Soc., 1887, p. 723.

Peridium up to 2 cm. diam., depressed-globose or shortly sub-pyriform, tapering abruptly into a short, stem-like base, attached to the substratum by numerous conspicuous, white mycelial strands; exoperidium of minute, partly fugacious, fasciculate, nodose spines, more prominent apically; endoperidium tough, membranous, darker apically, covered on the apical portion with minute depressions, appearing somewhat reticulate in consequence; sterile base scanty or absent, compact, pallid; diaphragm absent.

Gleba olivaceous, becoming umber; columella absent; capillitium simple or sparingly branched, hyaline, septate, not pitted, about twice the diameter of the spores. Spores globose, apedicellate, 3-4.4 μ diam.; epispore pallid olive, delicately verruculose.

Habitat.—On decaying wood on the forest floor.

Distribution.—North America; Australia.

New South Wales: *Bulli, Apl., 1910 (Det. Lloyd as *L. purpureum*); *Lisarow, June, 1916; *National Park, July, 1916; *Mt. Irvine, June, 1915.

Characterized by the peculiar pitted nature of the upper portion of the endoperidium, the hyaline, septate capillitium and very scanty, compact sterile base (which in some specimens may be absent). The habitat—decaying wood—is also characteristic, being peculiar to only two other Australasian species, *L. piriforme* and *L. compactum*, and should aid in diagnosis.

Lloyd has named one of the above collections as being *L. purpureum*, but in a later paper has shown that this was a misdetermination.

3. *LYCOPERDON COMPACTUM* G. H. Cunn. Plate xlv, figs. 6-7.

Trans. N.Z. Inst., lvii, 1926, 195.

Peridium up to 4 cm. diam., subglobose or pyriform, depressed above, compressed below into a short, stem-like base; exoperidium of strong brown spines, 3-4 mm. long, separate at the base, frequently connivent at the apices, surrounded by a ring of minute brown warts or granules, the spines partially disappearing with age, when the endoperidium appears reticulate from the presence of the persistent rings of granules; endoperidium membranous, ochraceous, becoming brown, dehiscing by an apical, plane, torn stoma; sterile base occupying the stem-like base, often rudimentary, minutely cellular, ochraceous; diaphragm absent.

Gleba olivaceous, pulverulent; columella small, elliptical; capillitium threads hyaline, sparsely branched or simple, septate, diameter of the spores, not pitted. Spores globose, 3.5-4.5 μ , with caducous pedicels up to 5 μ long; epispore olivaceous, closely and finely verrucose.

Habitat.—In small groups or caespitose on rotting wood on the forest floor.

Distribution.—New Zealand.

**Lake Papaetonga, Aug., 1919 (Det. Lloyd as *L. piriforme*. Sic.); **York Bay, Wellington, Feb., 1923, E. H. Atkinson (Type coll.).

The species is characterized by the spinous exoperidium, minutely cellular sterile base, hyaline, septate capillitium, and finely verrucose spores. It is peculiar in that it possesses certain characters of several species, for it has the exoperidium of *L. echinatum* Pers., compact, sterile base of *L. Hoylei* Berk., spores of *L. perlatum* Pers., and capillitium of *L. depressum* Bon.

The exoperidium is clothed with long (3-4 mm.), dark brown, almost black spines, which are free at their bases, but frequently connivent at their apices; at the base they are surrounded with a ring of numerous, coloured granules. When the spines fall away, as they do as the plant ages, the endoperidium appears reticulate, owing to the presence of these rings of granules, which persist and form a net-like series of fine lines.

The habit of growing upon wood is also a feature of the plant, being peculiar to only two other Australasian species, *L. piriforme* and *L. subincarnatum*.

4. *LYCOPERDON PIRIFORME* Schaeffer ex Persoon. Plate xlvii, figs. 8-9.

Syn. Meth. Fung., 1801, p. 149.—*L. piriforme* var. *flavum* Lloyd, *Letter No. 60*, 1915, p. 11.

Peridium up to 10 cm. diam., grey to bay brown, pyriform, subtrubinate or subglobose, with a compressed, slender, stem-like base; exoperidium of minute, scattered, brown or black, hemi-persistent, pointed verrucae and granules; endoperidium brown, membranous, dehiscing by an apical, small, plane, torn stoma; sterile base prominent, forming the stem-like base, cells large, pallid tan or yellowish; diaphragm absent.

Gleba greenish-yellow, becoming ferruginous or olivaceous; columella prominent, subglobose; capillitium threads olivaceous, sparingly branched or simple, continuous, not pitted, thick walled, about the diameter of the spores. Spores globose, 3.5-4.5 μ diam., apedicellate; epispore pallid olivaceous, finely verruculose.

Habitat.—Solitary, in groups, or caespitose on rotting wood on the forest floor, or on decaying logs and stumps.

Distribution.—Britain; North and South America; Europe; India; Japan; Australia; Tasmania; New Zealand.

Queensland: *Bunya Mts., Oct., 1915.

New South Wales: *No locality (4 collections).

South Australia: *Beaumont, May, 1923.

Tasmania: Hobart, L. Rodway, Herb. Nos. 1412, 1416.

New Zealand: **Lake Papaetonga, Aug., 1919; **Pokaka, Waimarino, Feb., 1922, D. Miller; **Weraroa, Aug., 1919; May, 1923; **Whakatikei, June, 1923, J. C. Neill; **Day's Bay, Apl., 1926, D. W. McKenzie.

Characterized by the minute verrucae of the exoperidium, the (usually) pyriform shape, finely verruculose spores and habit of growing upon rotting wood. It is liable to confusion only with *L. perlatum*, from which it may readily be separated by these characters.

4a. *LYCOPERDON PIRIFORME* var. *SEROTINUM* (Bon.) Hollos.

Gast. Hungary, 1904, p. 112.—*L. serotinum* Bonorden, *Bot. Zeit.*, 1857, p. 631.

Exoperidium persistent and broken into small areolae, giving to the peridium a reticulated appearance. Spores perfectly smooth. Other characters as above.

Distribution.—Britain; Europe; North America; Australia.

New South Wales: *Macquarie Pass, Aug., 1917.

The smooth spores are a distinctive feature of this collection, and the plant is really worthy of specific rank on this account, but as the writer has seen only one specimen, he cannot say whether this is a constant feature, so for the time follows Hollos in considering this a variety of *L. piriforme*.

5. *LYCOPERDON PERLATUM* Persoon. Plate xlvii, figs. 10-11.

Syn. Meth. Fung., 1801, p. 148.—*L. gemmatum* Batsch ex Auctt.—*L. excipuli-forme* (Scop.) Vitt., *Mon. Lyc.*, 1842, p. 193.—*L. montanum* Quel., *Champ. Dura*, 1876, p. 444.—*L. Colensoi* Cke. et Mass.; Mass. in *Jour. Roy. Micr. Soc.*, 1887, p. 711.—*L. tasmanicum* Mass., *Kew Bull.*, 1901, p. 158.—*L. macrogemmatum* Lloyd, *Myc. Notes*, 1906, p. 265.

Peridium up to 6 cm. diam., yellowish, becoming bay brown, subglobose, pyriform or turbinate, often tapering into a cylindrical, stem-like base; exoperidium of white, pointed verrucae, surrounded by a ring of smaller warts and granules, which give a reticulated appearance to weathered specimens; endoperidium bay brown, membranous, dehiscing by a small stoma situated at the apex of a definite umbo (which may be wanting); sterile base occupying the stem-like base, prominent, cells large, ferruginous, often tinged with purple; diaphragm absent.

Gleba yellowish, becoming olivaceous; columella prominent, elliptical; capillitium threads deep chestnut brown, sparsely branched or simple, continuous, not pitted. Spores globose, 3-5.4 μ diam., apedicellate; epispore pallid olivaceous, finely and closely verrucose.

Habitat.—Solitary, in groups or caespitose on the ground, usually in vegetable debris on the forest floor.

Distribution.—Britain; Europe; North and South America; India; East and South Africa; Algeria; Australia; New Zealand.

New South Wales: *Lismore, Oct., 1912; *Lisarow, June, 1916; *National Park, July, 1916; *Malanganee, Aug., 1917; *Comboyne, Sept., 1918.

Tasmania: *Hobart, F. R. Zeitz; Hobart, L. Rodway, Herb. No. 1413 (Type collection of *L. tasmanicum*).

New Zealand: **Weraroa, Jan., 1920; **Raurimu, Jan., 1920, E. H. Atkinson; **Whakatikei, June, 1923, J. C. Neill; **Orepuki, Nov., 1924, J. C. Neill.

The peculiar pointed verrucae of the exoperidium, which fall away and leave the endoperidium reticulate on account of the persistent smaller warts and

granules, form the chief character of this species. It is separated from *L. piriforme*, which otherwise it closely resembles, by this character, and by the spores, which are more strongly verrucose; then too, the sterile base is usually more deeply coloured, whereas it is usually pallid in *L. piriforme*. The spores are usually stated to be smooth, but this is an error, for all the collections listed above show these same verrucose spores.

The writer has examined type material of "*L. tasmanicum*," kindly donated by Mr. L. Rodway, and cannot see that it differs in any particular from *L. perlatum*. The verrucae are not so clearly defined as in the typical specimens, but this is not peculiar to *L. tasmanicum*, for several of the collections listed above possess small and poorly defined verrucae.

6. *LYCOPERDON STELLATUM* Cooke and Massee. Plate xlvii, fig. 12.

Grev., xv, 1887, p. 97.

Peridium depressed-globose, 2-3 cm. diam., with a small rooting base; exoperidium of stout, thick, connivent, pallid spines which fall away in small groups, but may persist towards base; endoperidium bay brown, or cream, smooth, save at the base where the exoperidium is partially persistent, membranous, dehiscing by a small, plane, torn, apical stoma; sterile base occupying the lower third of the peridium, ferruginous, cells minute, scarcely visible unless magnified; diaphragm absent.

Gleba ferruginous; columella absent; capillitium threads olivaceous, sparingly branched, continuous, thin walled, not pitted, about the diameter of the spores. Spores globose, 3.8-4.5 μ , apedicellate; epispore olivaceous, finely and closely verruculose.

Habitat.—Solitary on the ground.

Distribution.—Australia.

South Australia.—Israelite Bay, Type, in Herb. Kew; *Encounter Bay, Jan., 1925.

The peculiar nature of the exoperidium and small cells of the sterile base are the characters of the species.

Lloyd (1905, a) places it in his "*cruciatum*" section, but it differs from *L. candidum* (= *L. cruciatum*) in a most important character, namely, the absence of a diaphragm. The figure given by Massee (1887) is not characteristic, in that the spines are made much too coarse, and the sterile base is shown to be compact.

7. *LYCOPERDON NITIDUM* Lloyd. Plate xlvii, fig. 13.

Mycological Notes, 1924, p. 1305.

Peridium depressed globose, irregular, 2-4 cm. diam., umber, almost black, crenulate below, with a minute rooting base; exoperidium furfuraceous, flaking away irregularly, almost black; endoperidium papyraceous, umber, polished, dehiscing by a minute, plane, torn apical stoma; sterile base olivaceous, occupying the lower third of the peridium, cells minute, scarcely visible unless magnified; diaphragm absent.

Gleba olive-umber; columella absent; capillitium threads simple or sparingly branched, flaccid, olive, thin walled, pitted, continuous. Spores globose or sub-globose, apiculate, 3.5-4.5 μ diam.; epispore olivaceous, delicately verruculose.

Habitat.—On the ground.

Distribution.—Australia.

South Australia: *Clare, Aug., 1922, Type collection.

This species is characterized by the depressed-globose form, minutely furfuraceous exoperidium, the thin and polished umber brown endoperidium, scanty, minutely cellular sterile base and pitted capillitium.

Lloyd states that there is no sterile base, but this is an error for this structure occupies quite one-third of the peridium.

8. *LYCOPERDON SPADICEUM* Persoon. Plate xlvii, fig. 14.

Journ. Bot., ii, 1809, p. 20.—*L. Cookei* Mass., *Jour. Roy. Micr. Soc.*, 1887, p. 714.

Peridium 12-24 mm. diam., subglobose or more commonly shortly pyriform, with a long and slender rooting base, which may sometimes be branched; exoperidium furfuraceous, often in the form of mealy squamules, fugacious; endoperidium umber brown, papyraceous, smooth, dull, flaccid, sometimes covered with lime granules, dehiscing by an apical, torn, plane stoma; sterile base scanty, occupying the lower third of the peridium, or less, of small cells, umber; diaphragm absent.

Gleba olivaceous, becoming umber; columella absent; capillitium threads olivaceous, freely branched, continuous, not pitted, about the diameter of the spores. Spores globose, apiculate, 4-4.5 μ diam.; epispore olivaceous, minutely but distinctly verruculose.

Habitat.—Solitary on the ground.

Distribution.—Britain; Europe; Australia; New Zealand.

South Australia: *Mt. Lofty, June, 1921; July, 1922 (Det. Lloyd No. 851 as *L. pusillum*); *Big Swamp, west of Pt. Lincoln, May, 1923; *Beaumont, June, 1924 (2 collections); *Morphett Vale, Apl., 1925; *Kinchina, July, 1923; *Morialta, May, 1925; *F. R. Zeitz (3 collections).

Victoria: *Ararat, E. J. Semmens.

New Zealand: **Ashburton, Aug., 1925, J. C. Neill; **Kelburn, July, 1925.

Characterized by the small, sub-pyriform shape, furfuraceous exoperidium and scanty, small-celled, sterile base. The capillitium is freely branched, the plant differing in this respect from descriptions of the European form; but in other particulars it appears to be identical, even to the incrustation of lime granules on the exoperidium of occasional plants.

It closely resembles large forms of *L. pusillum*, but is separated readily on account of the presence of the cellular sterile base; and small forms of *L. polymorphum*, but the compact sterile base of the latter serves as a ready means of differentiation.

The New Zealand form collected at Kelburn possesses a more strongly developed exoperidium than is usual with this species; but in all other respects it is identical.

9. *LYCOPERDON POLYMORPHUM* Vittadini. Plate xlviii, fig. 15.

Mon. Lyc., 1842, p. 39.—*L. coloratum* Peck, *N.Y. Nat. Hist. Mus. 29th Rept.*, 1878, p. 29.—*L. furfuraceum* Schaeff. ex de Toni in Sacc. *Syll. Fung.*, vii, 1888, 110.—*L. cepaeforme* (Bull.) Mass., *Journ. Roy. Micr. Soc.*, 1887, p. 722.—*L. hungaricum* Hollos, *Mathem. Term.*, xix, 1901, p. 1.—*L. nigrum* Lloyd, *Lyc. Aus.*, 1905, p. 30.

Peridium up to 6 cm. diam., yellow, becoming brown, depressed globose or more frequently pyriform, with or without a stem-like base which, when present, is often crenulate; exoperidium of minute spines or verrucae, often furfuraceous, fugacious; endoperidium membranous, often smooth and polished, dehiscing by a

small, torn, plane, apical stoma; sterile base compact, of the same interwoven hyphae as the gleba, concolorous, frequently scanty; diaphragm absent.

Gleba yellowish, becoming olivaceous, columella absent; capillitium threads pallid olive, thin walled, branched, continuous, about the diameter of the spores. Spores globose, 4.5-5.5 μ diam., apiculate; episore tinted, closely and finely verruculose.

Habitat.—Solitary or in small groups on the ground.

Distribution.—Britain; Europe; North America; Algeria; South Africa; Australia; New Zealand.

New South Wales: *Milson Island, Hawkesbury River, Nov., 1914 (Det. Lloyd No. 86 as *L. cepaeforme* approaching *L. pusillum*); *Coolamon, May, 1918; *Bibbenluke, Mar., 1913; *Berrima, July, 1919.

South Australia: *Mt. Lofty, Apl., 1917; June, 1923; *Flinders Range, Aug., 1922; *Adelaide, F. R. Zeitz; *Ooldea, Aug., 1922; *Kinchina, July, 1923.

New Zealand: **Weraroa, Oct., 1919, E. H. Atkinson (Det. Lloyd as *L. cepaeforme*).

The species is characterized by the nature of the sterile base, which is either of a compact mycelial tissue similar in structure to the gleba, or of cells so minute as to be seen only when considerably magnified.

Frequently the sterile base is scanty, when plants approach *L. pusillum*; to this form the name *L. cepaeforme* has been applied, but it is impracticable to maintain, for in the same collection there may be present forms with either scanty or well developed sterile bases.

The spores are usually stated to be smooth, but they are closely and finely verruculose under the oil immersion.

The species is common in Australia, but has been collected but once in New Zealand.

10. LYCOPERDON PUSILLUM Persoon. Plate xlviii, fig. 16.

Jour. Bot., ii, 1809, p. 17.—*Bovista pusilla* Pers., *Syn. Meth. Fung.*, 1801, p. 138.—*Lycoperdon pusillum* (Batsch) Fries, *Syst. Myc.*, iii, 1829, p. 33.—*L. dermozanthum* Vitt., *Mon. Lyc.*, 1842, p. 34.—*Bovista dermozantha* (Vitt.) de Toni in Sacc. *Syll. Fung.*, vii, 1888, p. 100.—*B. pusilla* (Fr.) de Toni; Mass. in *Jour. Roy. Micr. Soc.*, 1887, p. 722.—*Lycoperdon mundulum* Kalchbr., *Grev.*, ix, 1880, p. 3.—*Bovista mundula* (Kalchbr.) de Toni, in Sacc. *Syll. Fung.*, vii, 1888, p. 98.—*Lycoperdon pseudopusillum* Hollos, *Noev. Koezi.*, ii, 1903, p. 75.—*L. semi-immersum* Lloyd, *Myc. Notes*, 1924, p. 1306.

Peridium up to 20 mm. diam., globose or suglobose, yellowish, becoming brown, with a strong basal rooting strand; exoperidium covered with minute, fugacious, mealy squamules or flattened verrucae, fugacious; endoperidium membranous, smooth, shining, flaccid, dehiscing by a small, irregular, plane apical stoma; sterile base absent.

Gleba yellowish, becoming brown; columella absent; capillitium threads olive, continuous, freely branched, pitted. Spores globose, 3.7-5 μ diam., apiculate; episore olive, finely but distinctly verruculose.

Habitat.—Scattered or in small groups on the ground, often in cultivated areas.

Distribution.—Britain; Europe; North America; China; East and South Africa; Ceylon; Australia; New Zealand.

New South Wales: *Merebine, Oct., 1918; *Forbes, Aug., 1915; *Milson Island, Hawkesbury River, Mar., 1915; Feb., 1916; *Wagga, July, 1914 (Det. Lloyd No. 88

as *L. cepaeforme*); *Narrabri, Nov., 1916; *Baan Baa, Jan., 1917; *Narrabeen, Mar., 1916; *Blue Mts., May, 1914; *Orange, Oct., 1914.

South Australia: *Overland Corner, July, 1921; *Adelaide, July, 1914 (2 collections); *F. R. Zeitz (2 collections); *Kinchina, July, 1925; *Ooldea, Aug., 1922 (Det. Lloyd as type of *L. semi-immersum*).

New Zealand: **Ashburton, Jan., 1925; May, 1925, J. C. Neill; **Roxburgh, May, 1925, J. C. Neill.

This is a small plant with a subglobose peridium, and small but strongly developed rooting base. It is characterized by the absence of a sterile base, flaccid, shining endoperidium and freely branched capillitium. It is separated from small forms of *L. polymorphum* and *L. spadiceum* principally by the absence of a sterile base.

The species is the most variable of this most variable genus; the spores vary considerably in size and degree of roughness; the capillitium may range from sparsely branched to freely branched; the size of the peridium from 5 mm. to 20 mm. or more. Needless to say most of these conditions have been named, but it is not practicable to maintain them owing to the difficulty of delimiting each.

The writer has examined type-collection material of *L. semi-immersum* Lloyd and finds that it agrees in all particulars with *L. pusillum*. It was stated to be growing partially buried in sand, and Lloyd apparently has made this the main character of the species, for although he states that the spores are larger, they were found on examination to be exactly the same size as those of *L. pusillum*.

That these particular plants were partially buried in sand was but an accidental circumstance, and cannot be considered to be of specific import.

One form, from Hawkesbury River, has distinctly obovate spores.

11. *LYCOPERDON GLABRESCENS* Berkeley. Plate xlviii, fig. 17.

Fl. Tas., II, 1860, p. 226.—*Bovistella glabrescens* (Berk.) Lloyd, *Lyc. Aus.*, 1905, p. 28.—*B. australiana* Lloyd, *l.c.*—*B. rosea* Lloyd, *Myc. Notes*, 1906, p. 248. Nomen nudum.

Peridium up to 5 cm. diam., bay brown, depressed globose or subglobose, often pyriform, tapering into a well developed stem-like base; exoperidium of small warts, larger towards the apex, fugacious; endoperidium bay brown, smooth, membranous, dehiscing by a small, erumpent, apical, torn stoma; sterile base well developed, cells small, often tinged with purple, occupying the stem-like base; diaphragm absent.

Gleba dark olivaceous, often purplish; columella wanting; capillitium threads freely branched, deeply coloured, about the diameter of the spores, pitted, continuous. Spores globose, 4.5 μ diam., pedicels tinted, acuminate; epispore olivaceous, minutely verruculose.

Habitat.—On the ground in groups, usually in pastures.

Distribution.—Australia; Tasmania; New Zealand.

New South Wales: *Milton Island, Hawkesbury River, Nov., 1914; *Sydney, Jan., 1915; June, 1916; *Mosman, Apl., 1915; *Manly, Apl., 1915 (Det. Lloyd No. 94 as *Bovistella australiana*); *Murwillumbah, Apl., 1916.

South Australia: *Mt. Dutton Bay, May, 1923; *Monarto South, July, 1922.

Victoria: Grantville, J. T. Paul, Herb. Vic. Dept. Agr. (Det. Lloyd as *Bovistella australiana*).

New Zealand: *No locality, J. B. Cleland; **Ashburton, Aug., 1925, J. C. Neill; D. W. McKenzie.

The members of the pedicellate-spored section of the genus are all—with one exception, *L. Gunnii*—closely related, and are separated mainly on the nature of the exoperidium.

In *L. glabrescens* the sterile base is prominent, but of small cells, a character tending to separate it from *L. asperum*, in which the sterile base is scanty and frequently almost wanting. The minutely verruculose exoperidium separates it from *L. scabrum*.

Lloyd has named this species *Bovistella australiana*, but as the species is well covered by the descriptions of *L. glabrescens* his specific name is considered superfluous. Lloyd's *Bovistella rosea* is considered a synonym, for it agrees in all particulars save the alleged rose (!) colour of the gleba.

12. *LYCOPERDON SCABRUM* (Lloyd) G. H. Cunn. Plate xlviii, figs. 18-19.

Bovistella scabra Lloyd, *Myc. Notes*, 1906, p. 282.—*B. nigrica* Lloyd, *Myc. Notes*, 1922, p. 1115.—*L. scabrum* G. H. Cunn., *Trans. N.Z. Inst.*, lviii, 1926, 199.

Peridium up to 3 cm. diam., depressed globose or pyriform, umber, with a well developed rooting base; exoperidium of long black or brown spines, 1-3 mm. long, free at the base, frequently connivent at the apices, fugacious; endoperidium umber, at length smooth, shining, membranous, dehiscing by an erumpent, torn, toothed apical stoma; sterile base occupying the lower third of the peridium, of small cells, concolorous; diaphragm absent.

Gleba olivaceous, becoming umber; columella absent; capillitium threads olivaceous, freely branched, pitted, continuous. Spores globose, 4-5 μ diam., pedicels acuminate, tinted; epispore olive, finely and evenly verruculose.

Habitat.—Solitary on the ground.

Distribution.—Australia; New Zealand.

South Australia: *Pearson Island, Gt. Australian Bight, Jan., 1923.

Victoria: Grantville, J. T. Paul (Det. Lloyd as *Bovistella scabra*), Herb. Vic. Dept. Agr.

New Zealand: **Weraroa, Oct., 1919, E. H. Atkinson; **Weraroa, Nov., 1919 (Type of *Bovistella nigrica*).

Characterized by the long spines of the exoperidium, and the well developed sterile base. It closely resembles the preceding, being separated on account of the cruciate spines of the exoperidium.

Lloyd's *Bovistella nigrica* is identical in all respects, save that of colour, with the specimens he has determined as *Bovistella scabra*; but the colour of the plants is not constant, for in one New Zealand collection are both brown (*B. scabra*) and dark brown (*B. nigrica*) specimens.

13. *LYCOPERDON ASPERUM* (Lev.) de Toni. Plate xlviii, figs. 20-21.

Sacc. *Syll. Fung.*, vii, 1888, p. 119.—*Bovista aspera* Lev., *Ann. Sci. Nat.*, ser. 3, v, 1846, p. 162.—*Lycoperdon australe* Berk., *Fl. Tas.*, ii, 1860, p. 266.—*Bovistella aspera* (Lev.) Lloyd, *Lyc. Aus.*, 1905, p. 29.

Peridium up to 3 cm. diam., bay brown, globose, depressed globose or pyriform, with a well developed rooting base; exoperidium of short, stout, pallid spines often convergent in fours at the apex, fugacious; endoperidium membranous, bay brown, smooth, dehiscing by a small, irregularly torn, plane apical stoma; sterile base scantily developed, of small cells; diaphragm absent.

Gleba pallid olivaceous; columella wanting; capillitium threads olivaceous, branched, pitted, continuous. Spores globose, 4-4.5 μ diam., pedicels acuminate, tinted; epispore pallid olive, minutely verruculose.

Habitat.—Solitary or in small groups on the ground.

Distribution.—Chile; New Guinea; South Africa; Australia; Tasmania.

New South Wales: *Blue Mts., Nov., 1914; *Sydney, Apl., 1915; *Milson Island, Hawkesbury River, Oct., 1914; *Penshurst, Feb., 1908 (Det. Lloyd as *Bovistella aspera*); *Macquarie Pass, Aug., 1917.

Victoria: *Ararat, May, 1918, E. J. Semmens; Dimboola, F. M. Reader (Herb. Vict. Dept. Agr.).

South Australia: *Adelaide, F. R. Zeitz; *Pearson Island, Gt. Australian Bight, Jan., 1923; *Mt. Lofty, July, 1922; *Monarto South, Sept., 1920 (Det. Lloyd as *Bovistella aspera*); *Mt. Compass, Aug., 1921.

Tasmania: Hobart, L. Rodway, No. 1417; Hobart, L. Rodway, No. 1418 (Det. Lloyd as *Bovistella australiana*).

Characterized by the (usually) minute sterile base and especially by the nature of the exoperidium, which is of short, stout, pallid spines often converging in fours at the apices. Plants vary considerably in the degree of the roughness of the spores, and depth of the colour of the capillitium, doubtless owing to many being collected before they were properly matured.

L. australe is by Lloyd considered a synonym of *L. pusillum*, but as the description calls for a plant with a rough exoperidium and pedicellate spores, it is by the writer considered a synonym of this species.

14. LYCOPERDON GUNNII Berkeley. Plate xlviii, fig. 22.

Fl. Tas., ii, 1860, p. 265.—*Bovistella Gunnii* (Berk.) Lloyd, *Lyc. Aus.*, 1905, p. 29.

Peridium 1-2 cm. diam., globose or subglobose, bay brown or yellowish-brown, with a small rooting base; exoperidium at first covered with minute warts, or tomentose, becoming flocculent and areolate when old; endoperidium bay brown, or yellowish, dehiscing by a small, irregularly torn, plane, apical stoma; sterile base absent, or seldom scantily developed.

Gleba yellowish, becoming olivaceous; columella absent; capillitium threads pallid olivaceous, or lemon yellow, thin walled, sparsely branched, continuous, pitted. Spores globose, 4-5 μ diam., pedicels tinted, acuminate; epispore tinted yellow, finely verruculose.

Habitat.—Solitary or in small groups on the ground.

Distribution.—Australia; Tasmania.

New South Wales: *Sydney, Apl., 1915 (Det. Lloyd No. 95 as *Bovistella Gunnii*); *Milson Island, Hawkesbury River, Nov., 1914; *Blayney, Dec., 1917; *Mummulgum, Dec., 1916.

Victoria: *Ararat, May, 1917, E. J. Semmens.

South Australia: *Big Swamp, west of Pt. Lincoln.

Tasmania: Hobart, L. Rodway, No. 1415.

A small subglobose plant with a poorly developed rooting base, the sterile base usually being absent. The yellowish nature of the gleba, capillitium and spores, sparingly branched, flaccid capillitium, small size of the peridium, and the furfuraceous nature of the exoperidium, are the specific characters of the species.

Doubtful or Excluded Species.

The following have been recorded in literature as having been collected in Australia or New Zealand. Most of the records are in Massee's Monograph (1887), in which he appears to have described as new every specimen in the Kew

Herbarium not placed in the cover of some well-known European species. Some idea of the quality of this work may be obtained from the fact that of the nineteen species recorded therein as having been collected in Australasia, four are, in the writer's opinion, correctly named. Needless to say, all species from Australasia recorded therein as new, are viewed with grave suspicion.

Cooke has compiled these, together with certain others, in his *Handbook* (1892); in this publication there are listed twenty-five species, of which five are correctly named.

- a. *Lycoperdon australe* Berk. = *L. asperum* (Lev.) de Toni.
- b. *L. Bovista* Fr. = *Calvatia gigantea* (Pers.) G. H. Cunn.
- c. *L. bovistoides* Cke. et Mass. = *Bovistella bovistoides* (Cke. et Mass.) Lloyd.
- d. *L. cepaeforme* (Bull.) Mass. = *L. polymorphum* Vitt.
- e. *L. caelatum* (Bull.) Fr. = *Calvatia caelata* (Bull.) Morg.
- f. *L. Colensoi* Cke. et Mass. = *L. perlatum* Pers.
- g. *L. Cookei* Mass. = *L. spadiceum* Pers.
- h. *L. coprophilum* Mass. = *Bovistella coprophila* (Mass.) G. H. Cunn.

In Dr. Cleland's possession are specimens which are well covered by the description of "*L. coprophilum*". The plants belong to the genus *Bovistella*, possessing the capillitium and rooting base of this genus.

- i. *L. cruciatum* Rostk. This, a synonym of *L. candidum* Bon., has been recorded by Lloyd as occurring in Australia, but the plants so labelled in the possession of Dr. Cleland (determined as such by Lloyd) are typically *L. depressum* Bon.
- j. *L. dermozanthum* Vitt. = *L. pusillum* Pers.
- k. *L. Fontanesii* D. et M. = *Calvatia caelata* (Bull.) Morg.
- l. *L. giganteum* Batsch = *Calvatia gigantea* (Pers.) G. H. Cunn.
- m. *L. gemmatum* Batsch = *L. perlatum* Pers.
- n. *L. lilacinum* (B. et M.) Mass. = *Calvatia lilacina* (B. et M.) Lloyd.
- o. *L. mundulum* Kalchbr. = *L. pusillum* Pers.
- p. *L. microspermum* Berk. = *L. pusillum* Pers.
- q. *L. natalense* Cke. et Mass. = *L. depressum* Bon.
- r. *L. nigrum* Lloyd = *L. polymorphum* Vitt.
- s. *L. novae-zelandiae* Lev. = *Calvatia lilacina* (B. et M.) Lloyd.
- t. *L. pseudopusillum* Hollos = *L. pusillum* Pers.
- u. *L. purpuraceum* Berk. (= *L. purpureum*). A misdetermination by Lloyd for *L. subincarnatum* Peck.
- v. *L. retis* Lloyd, *Myc. Notes*, 1923, p. 1176.

"About an inch in diameter with a slender tap root. Strongly reticulate (when dry at least) from what reason I do not know. Sterile base none. Gleba grey olive pale. Exoperidium smooth when old, but evidently (from remains) furfuraceous when young. Endoperidium thin, not dehiscing in any of these specimens. Capillitium long, subhyaline, scantily branched, hollow threads 5-6 μ thick, not septate as far as I could find. Spores globose, 4-5 μ , coloured, smooth.

"Victoria: E. J. Semmens.

"It grows in pastures and may be a *Calvatia*. The curious reticulations suggested at first that it was a *Clathrus* egg. Its relations are evidently close to the 'pratense' section, from which it differs in absence of a sterile base".

As Lloyd doubts the genus he should not have described the species from such faulty material.

- w. L. reticulatum* Berk. = *L. pusillum* Pers. probably.
- x. L. Sinciairii* Berk. = *Calvatia caelata* (Bull.) Morg.
- y. L. substellatum* B. et C. Probably a misdetermination of *L. subincarnatum* Peck, for Massee recorded it only from Cuba.
- z. L. tasmanicum* Mass. = *L. perlatum* Pers.
- aa. L. tephrum* Berk. = *L. subincarnatum* Peck.
- bb. L. violascens* Cke. et Mass. = *Calvatia lilacina* (B. et M.) Lloyd.

Literature Cited.

- COOKE, M. C., 1892.—Handbook of Australian Fungi. 457 pp. London.
 CUNNINGHAM, G. H., 1926.—Development of *Lycoperdon depressum*. *Jour. Sci. et Tech.*, vol. viii, p. 228, 1926.
 LLOYD, C. G., 1905 a.—The Lycoperdaceae of Australia, New Zealand and Neighbouring Islands. 44 pp. Cincinnati.
 ———, 1905 b.—The Lycoperdons of the United States. *Mycological Notes*, p. 221.
 ———, 1905 c.—The Genus *Lycoperdon* in Europe. *Mycological Notes*, p. 205.
 MASSEE, G. E., 1887.—A Monograph of the Genus *Lycoperdon* (Tournef.) Fr. *Journal of the Royal Microscopical Society*, p. 701.
 MORGAN, A. P., 1890.—North American Fungi. Third paper: The Gasteromycetes. Order II: Lycoperdaceae. *Journ. Cincinnati Soc. Nat. Hist.*, xii, p. 8, 163.

Index to Species and Synonyms.

Bovista.

aspera, 638; *dermoxantha*, 636; *mundula*, 636; *pusilla*, 636.

Bovistella.

aspera, 638-9; *australiana*, 637-9; *glabrescens*, 637; *Gunnii*, 639; *nigrica*, 638; *rosea*, 637-8; *scabra*, 638.

Lycoperdon.

asperum, 629, 630, 638, 640; *australe*, 638-640; *candidum*, 631, 634, 640; *cepaeforme*, 635-7, 640; *Colensoi*, 633, 640; *coloratum*, 635; *compactum*, 628-632; *Cookei*, 635, 640; *cruciatum*, 631, 634, 640; *depressum*, 627-8, 630-2, 640; *dermoxanthum*, 636, 640; *echinatum*, 632; *excipuliforme*, 633; *furfuraceum*, 635; *gemmatum*, 633, 640; *glabrescens*, 629-30, 637-8; *Gunnii*, 628-30, 638-9; *hiemale*, 631; *Hoylei*, 632; *hungaricum*, 635; *Kalchbrenneri*, 630; *macrogemmatum*, 633; *microspermum*, 640; *montanum*, 633; *mundulum*, 636, 640; *natalense*, 630, 640; *nigrum*, 635, 640; *nitidum*, 628, 630, 634; *perlatum*, 628-30, 632-4, 640; *piriforme*, 628-634; *piriforme* var. *flavum*, 632; *piriforme* var. *serotinum*, 633; *polymorphum*, 628-30, 635, 637, 640; *pratense*, 631; *pseudopusillum*, 636, 640; *pusillum*, 628-30, 635-7, 639-41; *retis*, 640; *scabrum*, 629-30, 638; *semi-immersum*, 636-7; *spadiceum*, 628-30, 635, 637, 640; *stellatum*, 628, 630, 634; *subincarnatum*, 628-32, 640; *subpratense*, 631; *tasmanicum*, 633-4; *tephrum*, 631; *Wrightii*, 630-1.

EXPLANATION OF PLATES XLVI-XLVIII.

Plate xlv.

- Fig. 1. *Lycoperdon depressum*, × 5/9. Showing variation in the nature of the exoperidium.
 Fig. 2. *L. depressum*, × 5/6. Showing (top) the crenulate, well-developed sterile base, and (bottom) the manner of dehiscence.
 Fig. 3. *L. depressum*, × 5/6. Showing the gleba, sterile base and prominent diaphragm.
 Fig. 4. *L. subincarnatum*, × 5/6. Australian plants with adhering exoperidium.
 Fig. 5. *L. subincarnatum*, × 3. Enlarged to show the pitted endoperidium. American plant.
 Fig. 6. *L. compactum*, × 5/6. Showing caespitose habit and ligneous habitat.
 Fig. 7. *L. compactum*, × 5/3. Note the reticulate endoperidium, long black spines of the exoperidium, and scanty sterile base.

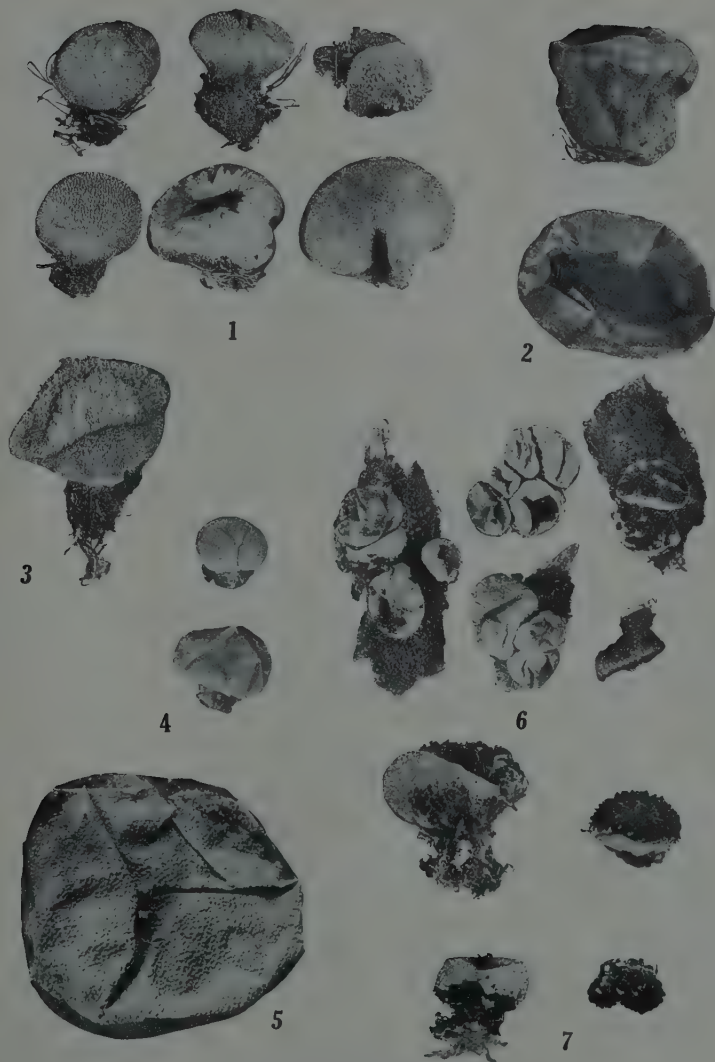
Plate xlvii.

- Fig. 8. *L. piriforme*, $\times 5/12$. Showing the varied shapes of the plants.
Fig. 9. *L. piriforme*, $\times 5/6$. Note the almost furfuraceous exoperidium.
Fig. 10. *L. perlatum*, $\times 5/12$. Australian and New Zealand plants showing the varied shapes of the plants; note the caespitose habit.
Fig. 11. *L. perlatum*, $\times 3$. European plant showing the peculiar verrucae which characterize the species. These verrucae are not so strongly developed in Australasian forms.
Fig. 12. *L. stellatum*, $\times 5/6$. Basal photo showing the rooting base and especially the remnants of the warted exoperidium.
Fig. 13. *L. nitidum*, $\times 5/6$. Immature plant with adhering exoperidium, above.
Fig. 14. *L. spadiceum*, $\times 5/6$. Sterile base shown in the sectioned plant. Note the furfuraceous exoperidium, which is more strongly developed than is usual (New Zealand plants).

Plate xlviii.

- Fig. 15. *L. polymorphum*, $\times 5/6$. Showing the diverse shapes.
Fig. 16. *L. pusillum*, $\times 5/6$.
Fig. 17. *L. glabrescens*, $\times 5/9$.
Fig. 18. *L. scabrum* $\times 5/9$. Showing the well-developed rooting base and the prominent torn stoma.
Fig. 19. *L. scabrum*, $\times 3$. Note the scabrous exoperidium.
Fig. 20. *L. asperum*, $\times 5/6$.
Fig. 21. *L. asperum*, $\times 3$. Showing the scabrous exoperidium.
Fig. 22. *L. Gunnii*, $\times 5/6$.

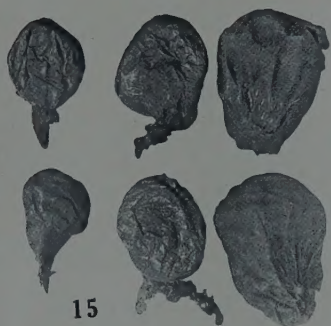
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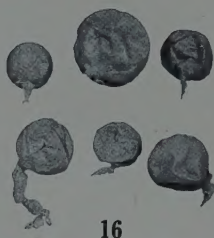
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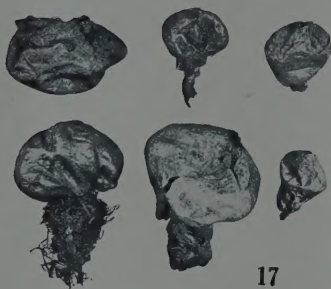
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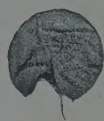
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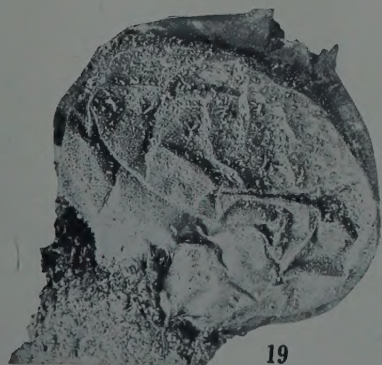
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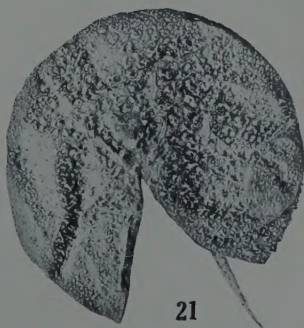
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